

# REPORT

## Brockton Receiving Water Assessment SEP

Prepared for  
*City of Brockton,  
Massachusetts*

March 31, 2011

*Supplemental Memorandum  
December 31, 2011*

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## Memorandum

*To: MassDEP*

*From: Julie Gagen, Karen Kelley, P.E., and Ian Mead*

*Date: December 31, 2011*

*Subject: Brockton Receiving Water Assessment SEP  
Response to MassDEP Comments dated September 8, 2011*

Comments were received from MassDEP on September 8, 2011, on the Brockton Receiving Water Assessment Supplemental Environmental Project (SEP) dated March 31, 2011. Not all feedback required a response. This memorandum addresses those comments. In addition, a revised report is included.

*Comment #1: From a technical standpoint, it is unfortunate that the Year 2 sampling (or even just the chemistry component) will not occur, apparently due to budget shortfall. The 2010 chemistry sampling was limited to one survey date. Another round in 2011 for at least NH<sub>4</sub>-N, TP and DO/T/pH/COND would be useful, in my opinion. From a management viewpoint, not sampling in 2011 is a significant deviation from the information contained in the revised Scope of Work and approved project QAPP. I suggest that the final report include an addendum describing all QAPP deviations.*

- The following text summarizes QAPP deviations. This memorandum will be attached as an addendum to the revised report.

### **Summary of Quality Assurance Project Plan (QAPP) Deviations** Brockton Receiving Water Assessment SEP Study- September 7, 2010

Section 1.1.1 – Paragraph 1. Page 1.  
(Also, Section 2.1.1 Sampling Schedule –Paragraph 2. Page 2.)

- The QAPP outlined two sampling rounds. With approval from MassDEP, the Comprehensive Receiving Water Assessment SEP consisted of one low-flow survey (taking place in August 2010). Resources to complete this effort exceeded the required expenditures of the SEP.



Section 1.3 – Page 11. Paragraph 5.

(Also, Section 1.6.2 Project Documentation and Records –Paragraph 3. Page 23)

- The QAPP specified two sampling rounds and two field completion memoranda. One field completion memorandum was produced. Sampling was not performed in Year 2.

Section 1.3 – Page 11. Paragraph 5.

(Also, Section 2.10.1 Data Handling – Page 33-37.)

- According to the QAPP, one of the formal deliverables of the sampling program is a database of water quality measurements. The database for this program consists of the data tables in the March 2011 report and summary data tables provided with this memorandum. In addition, raw data field sheets are included as attachments to the revised final report. The data tables are provided in electronic format accompanying the revised final report.

Section 1.4.2 – Page 17. Paragraph 2.

- The QAPP specified use of “distilled, deionized water” for chemical sampling field blanks and sampling equipment blanks. Distilled (not deionized) water was used for field QC samples. As a result, chemical analyses for samples BR1-105 and BR1-305 (the field and equipment blank, respectively) showed detections of the nitrogen compounds (ammonia-N, nitrate + nitrite (as N), dissolved inorganic nitrogen, dissolved organic nitrogen), as well as particulate organic nitrogen and trace total phosphorus (sample BR1-305 only). Concentrations of these chemicals were very similar in the equipment blank and field blank samples, which supports the hypothesis that the low levels observed originated in the distilled water.

Section 2.2.3 Diurnal DO measurements –Paragraph 1. Page 9.

(Also, Section 2.4.1 *In-situ* measurements –Paragraph 1. Page 20.)

- Afternoon Diurnal (PM) DO measurements from locations #1, #2, #9, and #10 were taken between 5 pm and 6 pm on September 2, outside of the prescribed 2 pm to 5 pm time window for sampling. However, it is believed that measurements are reasonably representative of peak DO levels in the river at these locations because hot, sunny conditions persisted throughout the late afternoon on that day and the river was still receiving direct sunlight at 6 pm.
- The DO probe on the YSI *in-situ* meter operated by Field Team #1 malfunctioned during sampling (Team #1 was responsible for collecting samples at Sample Locations #1 through #5). Very high DO readings were noted at Sample Location #4 at 7:30 am and again at Location #3 at 7:45 am. Field Team #1 had performed calibration procedures on the YSI meter before sampling Location #2 at 8:15 am; however the DO readings were still excessively high when the probe was used at Location #2 and Location #1. Due to delays caused by the equipment recalibration procedures, and the time limitations associated

with the diurnal sampling, use of the questionable equipment continued through the completion of the morning diurnal round. At 9 am calibration procedures were conducted a second time on the malfunctioning probe. The errors continued. Several calls were made to the equipment supplier and to Field Team #2 to coordinate a replacement meter. Following completion of the morning diurnal DO sampling, the field teams regrouped and the Field Program Coordinator determined that the third (spare) meter would be used for the remainder of the day by Field Team #1. Field Team #1 used the replacement meter for all subsequent water quality sampling and for the afternoon diurnal round of *in-situ* measurements.

Section 2.1.1 Sampling Activities – Paragraph 1. Page 4.

(Also, Section 2.1.1 Sampling Network Design and Rationale – Paragraph 1. Page 4.)

- The QAPP specifies that diurnal measurements will be made at each sampling location. Due to the malfunction of the DO probe experienced by one of the YSI meters during the morning of September 2, 2010, morning DO measurements collected on September 2 by Field Team #1 at Sample Locations #1, #2, #3, #4, and #5 were declared invalid and have been flagged as inaccurate (I) in accordance with the QAPP. Corrective action was taken in accordance with Section 2.2.6 of the QAPP and the measurements were repeated with the *in-situ* probe in the early morning hours of September 3, 2011 to collect the AM Diurnal DO measurements.
- Section 2.1.1 of the QAPP also states that DO will be measured concurrently with the *in-situ* probes by collecting Winkler samples, at all stations, to provide a check on the accuracy of the field probes. In general, the apparent time differences between Winkler sample collection time and field probe sampling time listed on Table 1 greatly exaggerate the time lapse between the two field activities. All water quality samples collected in bottles were assigned the sample time at which sampling commenced for each sampling location. However, at each station, the Winkler samples were collected as the last sample prepared for laboratory analysis. Directly after the Winkler samples were collected, the *in-situ* measurements were performed. (The exception is that, at Station #5, the Winkler sample was collected at 9:45 am, but the sample team forgot to perform *in-situ* measurements at that station at the time the Winkler sample was collected. The Field Program Coordinator discovered the omission and directed the sampling team to return to the site and make another measurement. The *in-situ* measurement was ultimately taken at 12:57 pm and does not coincide with the time of the Winkler sample at Station #5.)

Section 2.2.3 Diurnal DO measurements –Paragraph 2-3. Page 9.

- One mid-stream measurement was taken for DO, instead of samples at quarter-sections of the river as prescribed in the QAPP. Certain sections of river were inaccessible due to depth and flow of river; in other areas the width of the river was narrow and field teams

concluded that a single set of 3 measurements was sufficiently representative of the stream conditions.

Section 2.2.4 – Paragraph 1. Page 9.

- The QAPP outlines two sampling rounds; however Year 2 biological sampling was not performed due to budgetary constraints.

Section 3.1.1 – Paragraph 1. Page 1.

- An in-field audit was conducted by the Field Program Coordinator, not the Project Team Quality Assurance officer. The in-field audit consisted of observation and review of in-field sampling and documentation procedures during sampling for both teams. Both teams followed all in-field procedures according to the SAP, with the exception of QAPP deviations outlined in this Summary of QAPP Deviations.
- The Project Team Quality Assurance Officer conducted an audit in-house. The audit consisted of reviewing sampling procedures, field documentation, and data results.

Section 4.3 – Paragraph 1. Page 2.

- Data limitations were not identified by the subcontracted laboratory. No conclusions on validity were drawn from the data by the laboratory; however a Technical Memorandum was provided by the laboratory and can be found in Attachment F of the revised final report.

*Comment #2: Lab QC results appear acceptable for all samples.*

- No action items from this comment.

*Comment #3: Field QC results appear acceptable for all samples, except the NH<sub>4</sub>-N duplicate which was a little high (±8%RPD) and the field blank "hits" for NH<sub>4</sub>-N, DON and POC. See #7 below.*

- As specified in Section 1.4.2 Field Accuracy Objectives (Page 17) of the QAPP, field accuracy was assessed using post-sampling calibration checks for all field equipment. The results of the calibration checks can be found in Attachment B of the revised final report.
- Chemical sampling QC results were addressed in the response to comment #7.
- Field precision (%RPD) criteria for ammonia is less than or equal to 30%. The relative percent difference between Sample BR1-008 and duplicate Sample BR1-208 is 28%, which is high but is within the 30% criterion for precision specified in the QAPP.
- Field and Equipment blank samples (BR1-105 and BR1-305, respectively) were addressed under Comment #1 as a QAPP deviation because distilled water was used in lieu of distilled, deionized water. The results indicated detections consistent with impurities in

the distilled water. All of the other procedures outlined in the QAPP and SAP were followed to ensure cleanliness of field and equipment blanks.

*Comment #4A: Winkler DO results appear to compare well to field meter readings for site samples 2, 6, 7 and 8, but show poor (>0.5 diff.) to very poor (>1.0) comparison for sites 1, 3, 4, 5, 9 and 10. This inconsistency does not lend confidence to the DO data collected using field meters.*

- According to QAPP Section 1.4.2, “Comparability,” the comparability criterion of  $\pm 1.0$  mg/L was established to compare *in-situ* measurements with Winkler titration samples to assess performance of the DO probes. According to the summary of DO data presented in Table 2, six out of ten *in-situ* measurements met this objective criterion (Sample Locations 1, 2, 6, 7, 8, and 9). The other 4 measurements (Sample Locations 3, 4, 5, and 10) are qualified as not meeting the project quality objectives, in accordance with the QAPP.
- The procedure for making *in-situ* DO measurements is summarized as follows. As shown on the field sheets presented in Attachment C of the final revised report, DO readings were recorded at each sample location with the *in-situ* probe until stable values were obtained (5-minute minimum). Once the probes stabilized, DO measurements consisted of three consecutive readings of the *in-situ* parameters at each location, collected at approximate one minute intervals, which were averaged per SOP-FLD-003 and used to generate the values that are presented in the report. All reported DO measurements and supporting data recorded at each site are compiled in Attachment C of the revised report.
- As described in the Summary of QAPP deviations, in general, the apparent time differences between Winkler sample collection time and field probe sampling time listed on Table 1 greatly exaggerate the time lapse between the two field activities. All water quality samples collected in bottles were assigned the sample time at which sampling commenced for each sampling location. However, at each station, the Winkler samples were collected as the last sample collected for laboratory analysis. Directly after the Winkler samples were collected, the *in-situ* measurements were performed.
- Some observations related to the data variances between Winkler DO concentrations and YSI *in-situ* readings for DO are listed below.
  - Fluctuations in DO concentration of up to  $\pm 0.8$  mg/L at some sites, and as little as  $\pm 0.03$  mg/L at other sample locations, were observed over the course of several minutes during sampling. Water flowing rapidly past the probes appeared to generate greater variation in probe readings than was observed in more quiescent areas.
  - While the sampling protocol outlined in SOP-FLD-002 was followed at all times, there are several steps involved with collecting Winkler DO measurements. The field team

may have inadvertently caused a measurement error during processing of the Winkler sample.

- Field Team #1 (Sample Locations #1 through #5) appeared to have more difficulty obtaining comparable Winkler and *in-situ* data than did Field Team #2 (Sample Locations #6 through #10). This may indicate that perhaps there was something in the data collection procedures of Field Team #1 that was inconsistent with the applicable SOPs and was not detected during the time of sampling or through field QC checks. In contrast, the DO data from the field meters and Winkler titration are comparable in all cases for Field Team #2 except at Sample Location #10. Site Location #10 is a marshy, slow-moving area of the Town River. Sample Location #10 is located on the Town River upstream of the confluence of the Town River and the Matfield River, near Town Road at Hayward Street. It is not downstream of the Brockton AWRF.
- Recorded DO readings from Sample Locations #3, #4, and #5, and #10 fail to meet the QAPP's criterion for comparability. Additional investigation may be required to fully characterize DO at these locations.

*Comment #4B: Also, it is likely that the timing of the DO data collection resulted in capturing only a portion of the diurnal range at each site. The quantity of DO data presented (basically one early morning (although pre-dawn preferred) sample per site) is insufficient, by itself, for aquatic life use assessment, based on DWM's current assessment methodology requiring a minimum of 3 samples.*

- Continuous DO measurements using a probe deployed in the river, as compared with discrete field measurements using a hand-held probe, were not planned for this SEP.
- Per previous correspondence and scope identified in the QAPP/SAP and agreed to by MassDEP, the purpose of the SEP was to "help quantify water quality improvements as a result of the recent Brockton AWRF upgrades, and to supplement data collected during monitoring activities performed in the Taunton River Watershed in 2006" by Mass DEP. Ancillary to these objectives, it was noted that the information collected "could be used to support" an Aquatic Life Use status assessment; however, collecting a sufficient data set for making an aquatic life use assessment was not a primary objective of this SEP.
- One day of water quality sampling was envisioned in Year 1, and one day of water quality sampling was envisioned in Year 2 of this SEP. Due to budgetary constraints, Year 2 samples were not collected. However, one complete round of diurnal measurements was collected in 2010 for each of the 10 sampling stations. These measurements are discussed in additional detail in the response to comment 3.



*Comment #4C: Regarding Diurnal DO Survey field sheet for survey #1, site001, 9/2/10, were these the DO and DO-sat values that were actually displayed on the meter, e.g., 61.35 mg/l (due to QC problems that day) or are these showing a decimal place error?*

- The measurements at Site Location #1 on the morning of September 2 were recorded as they appeared on the meter. The high DO reading likely was a result and reflection of the meter malfunction which led to a second round of early morning DO measurements, collected on September 3, 2010.

*Comment #5: Information on low flow conditions and antecedent weather conditions look OK.*

- No action items from this comment.

*Comment #6A: Conductivity units should be uS/cm, not mS/cm.*

- Conductivity units were corrected.

*Comment #6B: Move "References" to end of document.*

- This report includes 14 pages of text, followed by Attachments A through G. The "References" section is located after the body of the 2010 Field Completion Report on page 14, before the appendices. In the PDF version of the document, the pages were ordered incorrectly. The page order has been corrected in the PDF.
- Attachment G – Biological Survey Results also includes a list of references following conclusion of the text, on page 17 of the attachment.

*Comment #7A: In general, the main report was sparse with respect to evaluating improvements to water quality that may have resulted from recent upgrades at the Brockton AWRF. This does not necessarily have to involve "data analysis", but can be a presentation of results as they relate to the goals of the sampling program, i.e., meeting project objectives.*

The following is a summary of the Sampling Program Goals:

“Chemical and biological sampling will be performed to provide data suitable for use by MassDEP to support an Aquatic Life Use status assessment. Within the \$80,000 upper limit budget constraint imposed by the Consent Decree, appropriate analytes, analyses, and sampling locations have been selected in conjunction with MassDEP and EPA, to help assess improvements to water quality that may have resulted from recent upgrades at the Brockton AWRF. Sampling will occur if flows are at or below August median low flows.”

The following is the summary of the final program:

- Chemical and biological sampling were performed, providing data that could be used to help support an Aquatic Life Use assessment.
- Expenditures met the requirements of the SEP.

The Water Quality monitoring data are discussed below in comparison to Massachusetts Surface Water Quality Standards. The Salisbury Plain and Matfield Rivers in the study area are classified as Class B Warm Water fisheries.

### **Massachusetts Surface Water Quality Standards – Class B Rivers**

The Massachusetts Surface Water Quality Standards for Class B Rivers specify criteria for DO, temperature, pH, bacteria, solids, color and turbidity, oil and grease, and taste and odor (314 CMR 4.05).

- **DO shall not be less than 5.0 mg/L** in warm water fisheries; “where natural background conditions are lower, DO shall not be less than natural background conditions.”
  - Two samples returned DO results less than 5.0 mg/L: Sample Location #7 and #10.
    - Morning DO sag at Sample Location #7 on 9/3 was recorded at 4.89 mg/L.
    - DO concentrations measured at Sample Location #10 were < 5.0 mg/L on all occasions, ranging from 1.76 – 4.13 mg/L. Sample Location #10 is on the Town River and is not downstream of the Brockton AWRF.
  - Sample Location #1 represents background (upstream) conditions. The diurnal DO range at this location was 6.12 mg/L (AM) to 7.44 mg/L (PM).

- All sample locations, with the exception of #2 and #9, were recorded with AM DO values lower than Sample Location #1, but higher than the 5.0 mg/L criteria for warm water fisheries. Afternoon (PM) DO readings above Sample Location #1 included Sample Location #2, #4, and #5.
- *In-situ* DO readings at Sample Locations #3, #4, and #5 indicating elevated afternoon DO concentrations did not meet the quality criteria outlined in the QAPP for comparability; however, Winkler DO samples collected at these sampling stations were within +/- 1.0 mg/L of background levels.
- **Temperature shall not exceed 83 degrees F (28.3 degrees C)** in warm water fisheries. The rise in temperature due to a discharge shall not exceed 5 deg F (2.8 deg C) in a rivers and streams designated as warm water fisheries (based on the minimum expected flow for the month).
  - Temperatures were comparable at Sample Location #1 and #2, upstream and downstream, respectively, of the Brockton AWRF.
  - All 10 stations were measured at less than 28.3 degrees C, meeting this criterion for a Class B river.
- **pH shall be in the range of 6.5 through 8.3 and not more than 0.5 units outside of the natural background range.**
  - One location, Sample Location #7 (pH 6.22), failed to meet the Massachusetts surface water quality standards for a Class B river for pH.
- **Bacteria** samples were not collected for this SEP.
- **Solids** were not analyzed for this SEP.
- **Color and Turbidity** were not assessed for this SEP.
- **Oil and Grease** was not assessed for this SEP; however no visible films were observed on the surface of the water.
- **Taste and Odor** were not assessed for this SEP, but no objectionable odors were noted during sampling.

*Comment #7B: Also, the quality of the chemistry data as indicated by the field QC sample results was not discussed.*

Field QC sample results are discussed in this memorandum. A Summary of the chemistry data quality is provided below.

#### **Summary of Data Validation Objectives**

- A technical memorandum from SMAST, the laboratory which completed chemical analysis for this program, was released on November 16, 2010. This technical memorandum (attached) covers all analyses completed by the laboratory and details laboratory duplicate analysis and standard additions run during sample analyses. According to this memorandum, data quality objectives were met for all chemical analyses conducted under this program.
- In addition to chemical analyses, biological data were analyzed. While no specific memorandum was developed on the data quality of this assessment, it is discussed within the Biological Monitoring Report in Attachment G of the report. Per the results and discussion in that report, the data quality objectives for biological monitoring were achieved.
- The data collected in this investigation appear representative of the actual site in terms of physical and chemical conditions, and with certain exceptions discussed in this memorandum, have met the objectives outlined for Year 1 Sampling. All planned samples were collected and analyzed, as outlined in the scope.

# Brockton Receiving Water Assessment SEP

September 2010 Low-Flow Water Quality Survey

**Table 1. Laboratory Results from UMass Dartmouth SMAST Laboratory**

		Ortho- Phosphate (PO <sub>4</sub> )	Total Phosphorus (TP)	Ammonia (NH <sub>4</sub> )	Nitrate + Nitrite (NO <sub>x</sub> )	Dissolved Inorganic Nitrogen (DIN)	Dissolved Organic Nitrogen (DON)	Particulate Carbon (POC)	Particulate Nitrogen (PON)	Carbon/ Nitrogen Ratio (C/N)	Chloro- phyll-a (Chl-a)	Phaeo- pigment (Phaeo)	Chlorophyll-a/ Total Pigment Chl-a/Chl-a+Phaeo	Total Pigment Chl-a + Phaeo
Sample ID	Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Ratio	ug/L	ug/L	ratio	ug/L
BR1-001	9/2/2010	0.018	0.048	0.190	0.709	0.899	0.379	0.542	0.069	9.21	1.03	<0.05	1.0	1.06
BR1-002	9/2/2010	0.016	0.055	0.644	2.18	2.82	0.549	0.551	0.07	9.25	0.62	0.11	0.85	0.72
BR1-003	9/2/2010	0.015	0.054	0.377	2.30	2.68	0.551	0.423	0.052	9.49	0.56	0.07	0.90	0.62
BR1-004	9/2/2010	0.008	0.026	0.111	0.438	0.549	0.627	0.388	0.047	9.54	0.60	0.12	0.83	0.72
BR1-005	9/2/2010	0.028	0.047	0.139	2.29	2.43	0.645	0.719	0.072	11.6	0.71	0.22	0.77	0.93
BR1-006	9/2/2010	0.018	0.042	0.117	0.684	0.801	0.641	0.735	0.087	9.87	3.02	<0.05	1.0	3.05
BR1-007	9/2/2010	0.045	0.075	0.056	0.174	0.229	0.569	0.679	0.084	9.48	5.39	<0.05	1.0	5.42
BR1-008	9/2/2010	0.020	0.049	0.113	2.42	2.53	0.533	0.384	0.043	10.5	0.70	0.16	0.82	0.85
BR1-208 <sup>1</sup>	9/2/2010	0.018	0.046	0.085	2.35	2.44	0.508	0.383	0.041	11.0	0.61	0.08	0.88	0.69
BR1-009	9/2/2010	0.025	0.064	0.069	2.01	2.08	0.441	0.353	0.038	10.7	2.65	<0.05	1.0	2.68
BR1-010	9/2/2010	0.005	0.018	0.047	0.308	0.355	0.402	0.432	0.047	10.8	1.18	<0.05	1.0	1.20
BR1-105 <sup>2</sup>	9/2/2010	<0.003	<0.002	0.073	0.003	0.076	0.122	0.033	0.002	15.6	<0.05	<0.05	NA	<0.05
BR1-305 <sup>3</sup>	9/2/2010	<0.003	0.002	0.073	0.007	0.079	0.158	0.038	0.003	12.8	<0.05	<0.05	NA	<0.05

1. Sample BR1-208 is the field duplicate for Sample BR1-008

2. Sample BR1-105 is the field blank

3. Sample BR1-305 is the equipment blank

**Brockton Receiving Water Assessment SEP**

September 2010 Low-Flow Water Quality Survey

**Table 1a. Field Precision Calculations for Duplicate Sample BR1-208**

		Ortho- Phosphate (PO <sub>4</sub> )	Total Phosphorus (TP)	Ammonia + N (NH <sub>4</sub> )	Nitrate + Nitrite (NO <sub>x</sub> )	Dissolved Inorganic Nitrogen (DIN)	Dissolved Organic Nitrogen (DON)	Particulate Carbon (POC)	Particulate Nitrogen (PON)	Chloro phyll-a (Chl-a)
Sample ID	Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	ug/L
BR1-008	9/2/2010	0.020	0.049	0.113	2.42	2.53	0.533	0.384	0.043	0.70
BR1-208 <sup>1</sup>	9/2/2010	0.018	0.046	0.085	2.35	2.44	0.508	0.383	0.041	0.61
% RPD	--	11%	6%	28%	3%	4%	5%	0.3%	5%	14%
Field Precision Limit		30%	30%	30%	30%	30%	30%	30%	30%	30%

1. Sample BR1-208 is the field duplicate for Sample BR1-008
2. Grey shading refers to calculated %RPD which exceeds limit established by the QAPP dated September 7, 2010



# Brockton Receiving Water Assessment SEP

September 2010 Low-Flow Water Quality Survey

**Table 2. Summary of all DO Information Collected on 9/2 - 9/3 Sampling Round**

Sample Location # - description	9/2/10 - AM YSI DO Reading		9/2/10 - Winkler DO Measurement		YSI DO Reading @time of sample		9/2/10 - PM DO Reading		9/3/10 - AM DO Reading	
	Time	(mg/L)	Time	(mg/L)	Time	(mg/L)	Time	(mg/L)	Time	(mg/L)
1 - U/S of Brockton AWRF	8:46	[61.35] <sup>(i)</sup>	14:00	6.89	14:38	6.08	17:29 <sup>(r)</sup>	7.44	8:16	6.12
2 - D/S of Brockton AWRF	8:27	[6.72] <sup>(i)</sup>	13:00	7.13	13:43	7.48	17:11 <sup>(r)</sup>	7.57	7:54	6.42
3 - Salisbury Plain R. at Matfield St.	7:51	[9.15] <sup>(i)</sup>	12:00	6.38	12:17	7.61 <sup>(d)</sup>	16:48	6.36	7:26	5.32
4 - Beaver Brook at Belmont St.	7:31	[24.32] <sup>(i)</sup>	11:25	7.18	11:39	10.54 <sup>(d)</sup>	16:07	8.71	7:08	5.53
5 - Matfield R. at Plymouth St.	7:12	[35.63] <sup>(i)</sup>	9:45	6.78	12:57	9.76 <sup>(d)</sup>	15:50	9.02	6:50	6.00
6 - Meadow Brook at Belmont St.	7:10	5.07	10:00	5.57	10:33	5.59	14:45	5.73	--	--
7 - Satucket R. at Plymouth St.	7:40	5.06	11:00	6.68	11:25	6.53	15:05	7.35	8:47	4.89
8 - Matfield R. at State Hwy 18	8:08	6.10	11:50	6.46	12:03	6.40	16:45	6.91	9:08	6.36
9 - Matfield R. at High St.	8:40	6.30	13:00	7.17	13:20	6.54	17:10 <sup>(r)</sup>	7.43	9:28	6.24
10 - Town R. at Hayward St.	9:05	3.71	13:40	6.65	14:03	1.76 <sup>(i)</sup>	17:25 <sup>(r)</sup>	4.13	9:49	4.07

r = Data may not be representative of actual field conditions. Diurnal DO (PM) samples collected after 5pm

i = Inaccurate readings from multi-probe likely; may be due to significant pre-survey calibration problems, post-survey checks outside typical acceptance ranges for the low ionic and deionized water checks, lack of calibration of the depth sensor prior to use, or to checks against laboratory analyses. Where documentation on unit pre-calibration is lacking, but SOPs at the time of sampling dictated pre-calibration prior to use, then data are considered potentially inaccurate.

d = did not meet project data quality objectives identified for program or in QAPP. Flagged as not meeting project quality objectives due to difference between Winkler and field in-situ probe results.

Note : a criterion of +/- 1.0 mg/L was established to compare Winkler to YSI results (QAPP Section 1.4.2)

A result reported inside brackets [] has been "censored," but is shown for informational purposes.

# Brockton Receiving Water Assessment SEP

September 2010 Low-Flow Water Quality Survey

**Table 3. Field Measurements**

Sample Location		Units	Acceptable Ranges	1 - U/S of Brockton AWRF					2 - D/S of Brockton AWRF				3 - Salisbury Plain R. at Matfield St.				
Sample Round				am	noon	pm	pm <sub>dup</sub>	3-Sep	am	noon	pm	3-Sep	am	noon	pm	pm <sub>dup</sub>	3-Sep
Parameter	Time	--	--	8:46	14:38	17:29	17:36	8:16	8:27	13:43	17:11	7:54	7:51	12:17	16:22	16:48	7:26
	Temp	°C	<= 28.3	22.53	23.83	24.20	24.20	21.75	22.98	23.84	24.07	22.64	22.54	23.38	24.20	24.22	22.49
	Conductivity	us/cm	--	354	483	495	495	466	513	678	671	619	454	651	668	670	597
	Sp. Cond.	us/cm <sup>c</sup>		371	494	503	503	497	534	694	684	648	476	672	678	681	627
	DO	mg/L	>= 5.0	61.35	6.08	7.44	7.45	6.12	6.72	7.48	7.57	6.42	9.15	7.61	10.93	6.36	5.32
	DO	%	--	677.8	72.3	88.9	88.8	69.9	78.1	88.8	90.2	74.5	106.2	89.2	130.6	76.1	61.4
	Turbidity	NTU	--	--	3.37	--	--	--	--	2.74	--	--	--	2.96	--	--	--
	pH	--	6.5 - 8.3	--	--	--	--	6.69	--	--	--	6.94	--	--	--	--	6.9

Sample Location		Units	Acceptable Ranges	4 - Beaver Brook at Belmont St.				5 - Matfield R. at Plymouth St.					6 - Meadow Bk. at Belmont St.				7 - Satucket R. at Plymouth St.			
Sample Round				am	noon	pm	3-Sep	am	noon	pm	pm <sub>dup</sub>	3-Sep	am	noon	pm	3-Sep	am	noon	pm	3-Sep
Parameter	Time	--	--	7:31	11:39	16:07	7:08	7:12	12:57	15:43	15:50	6:50	7:10	10:33	14:45	--	7:40	11:25	15:05	8:47
	Temp	°C	<= 28.3	21.32	23.03	24.72	21.74	22.48	22.88	24.37	24.39	22.81	22.35	22.55	24.61	--	24.14	25.21	26.94	24.78
	Conductivity	us/cm	--	226	304	316	290	467	585	614	617	612	487	491	488	--	260	261	258	260
	Sp. Cond.	us/cm <sup>c</sup>		243	316	318	309	490	609	621	625	639	463	468	485	--	256	262	268	261
	DO	mg/L	>= 5.0	24.32	10.54	8.71	5.53	35.63	9.76	7.92	9.02	6.00	5.07	5.59	5.73	--	5.06	6.53	7.35	4.89
	DO	%	--	235.6	123.0	105.0	63.3	446.7	113.8	95.0	108.3	69.8	58.5	64.8	69.0	--	60.2	79.4	92.2	58.9
	Turbidity	NTU	--	--	1.41	--	--	--	1.79	--	--	--	--	1.84	--	--	--	5.04	--	--
	pH	--	6.5 - 8.3	--	--	--	6.91	--	--	--	--	7.1	6.59	--	--	--	--	--	--	6.22

Sample Location		Units	Acceptable Ranges	8 - Matfield R. at State Hwy 18						9 - Matfield R. at High St.				10 - Town R. at Hayward St.			
Sample Round				am	noon	pm <sub>dup</sub>	pm	pm <sub>dup</sub>	3-Sep	am	noon	pm	3-Sep	am	noon	pm	3-Sep
Parameter	Time	--	--	8:08	12:08	12:21	16:45	17:02	9:08	8:40	13:20	17:10	9:28	9:05	14:03	17:25	9:49
	Temp	°C	<= 28.3	22.57	23.32	23.37	24.29	24.3	23	23.14	24.39	24.79	23.55	21.09	23.82	24.5	21.39
	Conductivity	us/cm	--	594	596	596	592	592	596	548	569	551	501	288	278	291	265
	Sp. Cond.	us/cm <sup>c</sup>		566	577	578	584	584	620	528	563	549	515	267	271	288	285
	DO	mg/L	>= 5.0	6.1	6.37	6.4	6.91	6.91	6.36	6.3	6.54	7.43	6.24	3.71	1.76	4.13	4.07
	DO	%	--	70.6	74.9	75.2	82.6	82.6	74.2	73.7	78.4	89.6	73.7	41.4	20.9	49.9	45.8
	Turbidity	NTU	--	--	4.6	3.2	--	--	--	--	3.45	--	--	--	2.64	--	--
	pH	--	6.5 - 8.3	--	--	--	--	--	7.12	--	--	--	7.15	--	--	--	6.71

1. Grey highlight refers to Massachusetts Surface Water Quality Standards exceedances.

**Brockton Receiving Water Assessment SEP**

September 2010 Low-Flow Water Quality Survey

**Table 4. In-situ Field Meter Duplicate Measurements**

Sample Location		Units	Acceptable Ranges	1 - U/S of Brockton AWRP		
Sample Round				pm	pm (dup)	RPD
Parameter	Time	--	--	17:29	17:36	--
	Temp	°C	<= 28.3	24.2	24.2	<1%
	Conductivity	us/cm	--	495	495	<1%
	Sp. Cond.	us/cm <sup>c</sup>	--	503	503	<1%
	DO	mg/L	>= 5.0	7.44	7.45	<1%
	DO	%	--	88.9	88.8	<1%
	Turbidity	NTU	--	--	--	--

Sample Location		Units	Acceptable Ranges	3 - Salisbury Plain R. at Matfield St.		
Sample Round				pm	pm (dup)	RPD
Parameter	Time	--	--	16:22	16:48	--
	Temp	°C	<= 28.3	24.2	24.22	<1%
	Conductivity	us/cm	--	668	670	<1%
	Sp. Cond.	us/cm <sup>c</sup>	--	678	681	<1%
	DO	mg/L	>= 5.0	10.93	6.36	53%
	DO	%	--	130.6	76.1	53%
	Turbidity	NTU	--	--	--	--

Sample Location		Units	Acceptable Ranges	5 - Matfield R. at Plymouth St.		
Sample Round				pm	pm (dup)	RPD
Parameter	Time	--	--	15:43	15:50	--
	Temp	°C	<= 28.3	24.37	24.39	<1%
	Conductivity	us/cm	--	614	617	<1%
	Sp. Cond.	us/cm <sup>c</sup>	--	621	625	1%
	DO	mg/L	>= 5.0	7.92	9.02	13%
	DO	%	--	95	108.3	13%
	Turbidity	NTU	--	--	--	--

Sample Location		Units	Acceptable Ranges	8 - Matfield R. at State Hwy 18		
Sample Round				noon	noon (dup)	RPD
Parameter	Time	--	--	12:08	12:21	--
	Temp	°C	<= 28.3	23.32	23.37	<1%
	Conductivity	us/cm	--	596	596	<1%
	Sp. Cond.	us/cm <sup>c</sup>	--	577	578	<1%
	DO	mg/L	>= 5.0	6.37	6.4	<1%
	DO	%	--	74.9	75.2	<1%
	Turbidity	NTU	--	4.6	3.2	--

Sample Location		Units	Acceptable Ranges	9 - Matfield R. at State Hwy 18		
Sample Round				pm	pm (dup)	RPD
Parameter	Time	--	--	16:45	17:02	--
	Temp	°C	<= 28.3	24.29	24.3	<1%
	Conductivity	us/cm	--	592	592	<1%
	Sp. Cond.	us/cm <sup>c</sup>	--	584	584	<1%
	DO	mg/L	>= 5.0	6.91	6.91	<1%
	DO	%	--	82.6	82.6	<1%
	Turbidity	NTU	--	--	--	--

1. Grey highlight refers to exceeding acceptable ranges as outlined in the QAPP

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## ADDITIONAL ATTACHMENTS (ELECTRONIC VERSION ONLY)

<b>Attachment H. Full USGS Streamflow Data Set .....</b>	<b>H</b>
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# BROCKTON RECEIVING WATER ASSESSMENT SEP 2010 FIELD COMPLETION REPORT

March 31, 2011

## INTRODUCTION

On September 2, 2010 two CDM field teams traveled to ten sample locations for the City of Brockton Receiving Water Assessment Supplemental Environmental Project (SEP) water quality survey of surface water in the Taunton River Watershed. In accordance with the approved Quality Assurance Project Plan (QAPP) and subsequent Sampling and Analysis Plan (SAP), field parameters, chemical, and biological sampling was performed (CDM, 2010(a) and CDM, 2010(b)).

Each sample location was assessed for dissolved oxygen (DO), pH, turbidity, and conductivity with a field parameter meter (YSI) and for nitrogen series, chlorophyll-a, and total and dissolved orthophosphorus using laboratory sample bottles and subsequent analysis. The site number, watercourse, and parameter information can be found in the Final SAP, dated September 7, 2010. **Table 1** summarizes sample locations and the subsequent analyses performed. Monitoring station locations are shown on **Figure 1** and are detailed in **Attachment A**.

Biological data was collected at six sampling stations on the mainstem Salisbury Plain and Matfield Rivers to characterize the impacts of improvements to the Brockton AWRF on the river. The biological monitoring program included macroinvertebrate surveys and habitat assessments.

Chemical sampling was performed by two teams of CDM staff, lead by CDM Field Program Coordinator Julie Gagen, and included Chris Buerkle, Steven Carey, and Danielle Lemoi. Project Personnel Sign-Off Sheets are included in **Attachment A**. Biodrawversity, who conducted biological sampling fieldwork, was coordinated and led by Biodrawversity Field Program Coordinator Ethan Nedeau.

**Table 1. Sample Locations and Analyses**

Sampling Category	Station	Chemical	Biological	Fish
Background Sampling	1 – Upstream of the Brockton AWRF	X	X	
	2 – Downstream of the Brockton AWRF	X	X	
Source Sampling	4 – Beaver Brook at Belmont St.	X		
	6 – Meadow Brook at W. Union Street	X		
	7 – Satucket R. at Plymouth St	X		
	3 – Salisbury Plain R. at Matfield Street	X	X	X
In-stream Response	5 – Matfield R. at Plymouth St.	X	X	X
	8 – Matfield R. at State Hwy 18	X	X	X
	9 – Matfield R. at High St.	X	X	
	10 – Town R. at Hayward St.	X		

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Introduction

Sampling Event  
Antecedent Conditions

Sample Collection and  
Field Activities Records

Laboratory Data Reporting  
Package

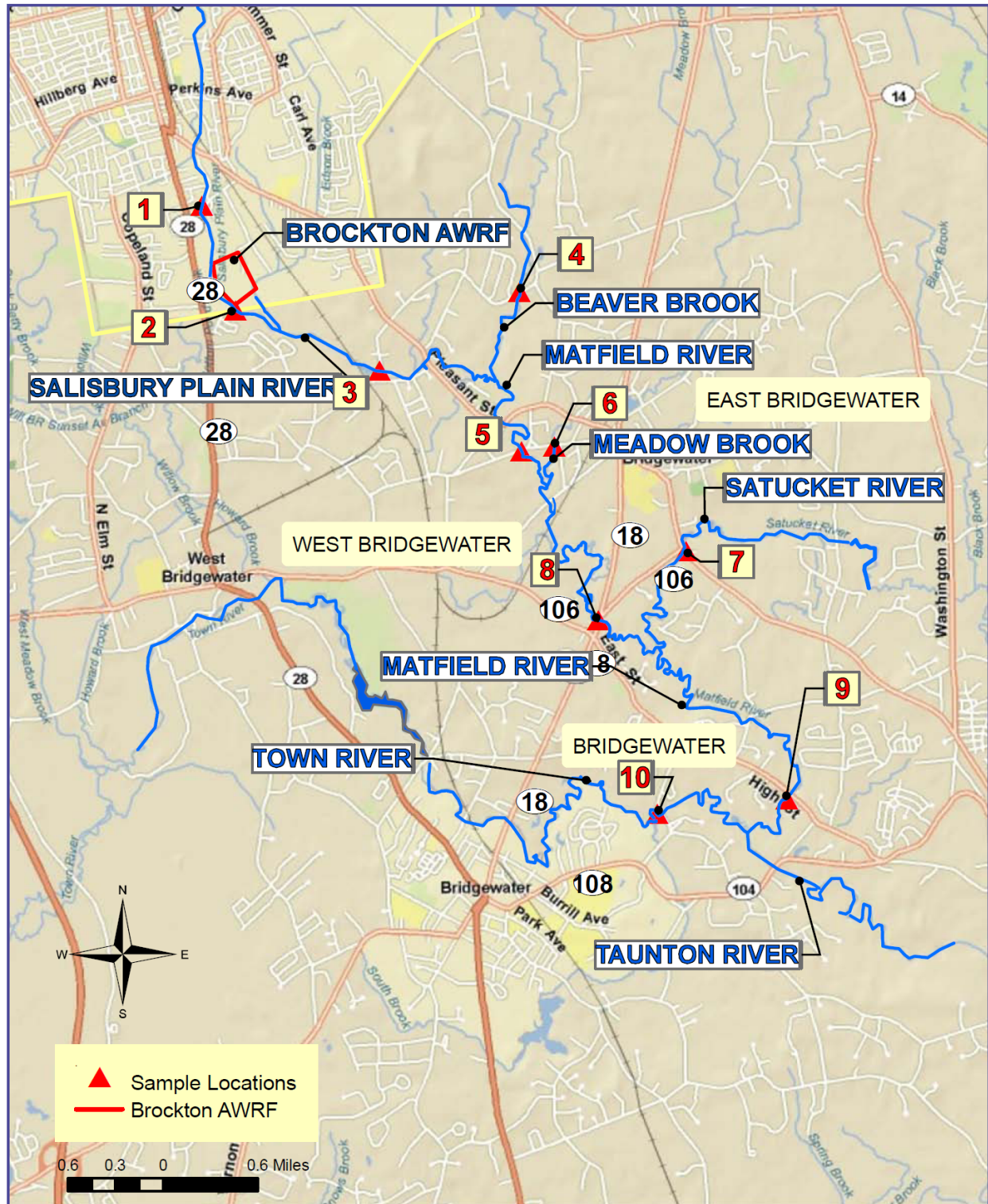
Biological Surveys  
Reporting Package

Quality Assurance/Quality  
Control and Data  
Validation

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Attachments

Figure 1. Brockton Receiving Water Assessment SEP 2010-2011 Monitoring Stations

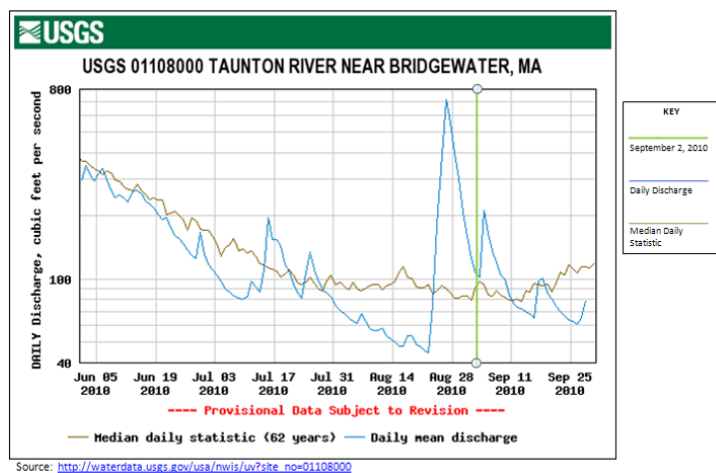


## SAMPLING EVENT ANTECEDENT CONDITIONS

### Weather Tracking

Sampling was targeted for August low-flow conditions. In preparation for sampling, the CDM Project Team collected precipitation and streamflow data reported by the National Oceanographic and ([www.erh.noaa.gov](http://www.erh.noaa.gov)) and USGS streamflow monitoring gage #01108000 Taunton River for the period of ten days prior to sampling. The target streamflow value for low-flow conditions, August median flow at Taunton River gage #01108000, was determined to be 92 cfs or less, as described in the project SAP.

**Figure 2. USGS Daily Mean and Median Streamflow Discharge, June 1 – September 30, 2010, USGS Gage #01108000,**



Target antecedent rainfall conditions for sampling also required a total less than 0.1 inch of precipitation in 48 hours preceding the low-flow survey at the Taunton, Massachusetts NOAA weather station (<http://www.erh.noaa.gov/box/daily/stns.shtml>). Precipitation records for the sample period can be found in Table 2.

### Antecedent Sampling Conditions

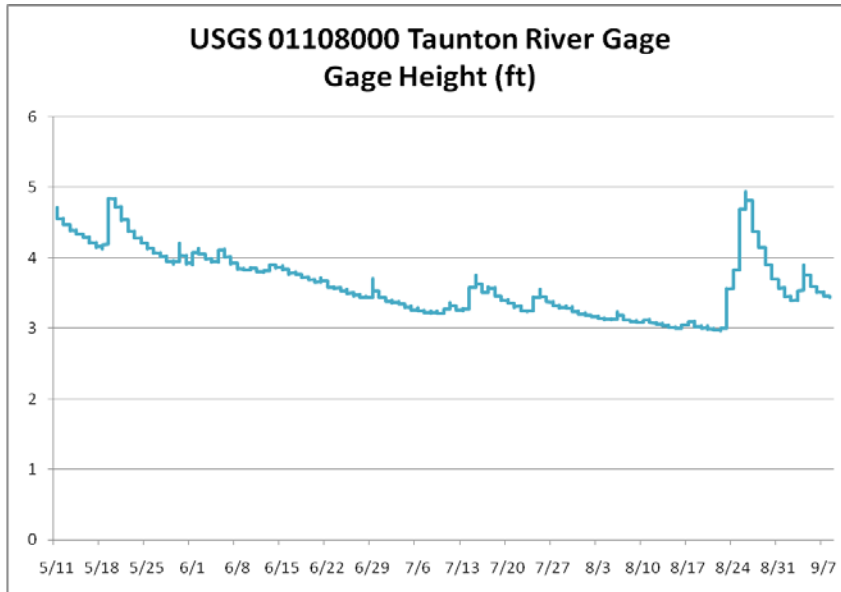
Water quality sampling was performed September 2, after several days of hot and dry weather, with high temperatures in the low-

90s F. Actual streamflow recorded at the USGS Taunton River gage the day of sampling was 107 cfs, which exceeded the 92 cfs target by approximately 16 percent. The target streamflow for this event was exceeded due to a large storm system which, over the course of 48 hours, released more than 2 inches of rain in mid-August. This storm resulted in a spike in streamflow exceeding 700 cfs on August 26. Sampling was conducted after 7 days of hot, dry weather. The decision was made to sample on September 2 because Hurricane Earl was forecast to arrive in southern Massachusetts imminently after that date. Sampling was planned for September 2 to avoid missing the opportunity to collect samples representing summer low-flow conditions during the 2010 season, which likely would be lost as a result of the effects of the hurricane. Meteorological data for the period antecedent to sampling can be found trailing this memorandum, in **Attachment A**.

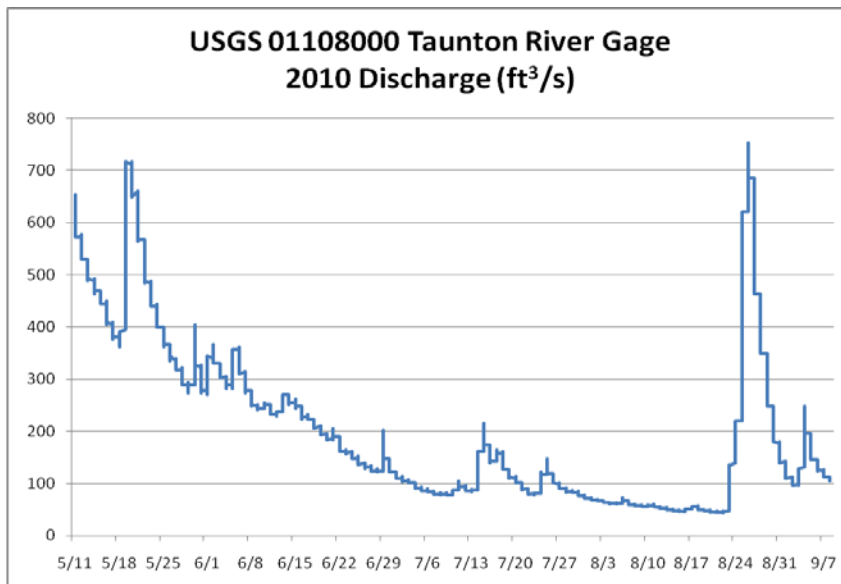
### Field Mobilization for Water Quality Sampling

CDM and Biodrawversity teams conducted an initial site location assessment on August 4, 2010 to assess conditions, identify sample locations, access constraints, and determine ideal sampling locations. Upon completion of the assessment, Biodrawversity mobilized a team to deploy benthic sampling equipment with approximately three weeks of lead time, so that the chemical and biological surveys could be completed at the same time.

Once antecedent conditions met basic QAPP/SAP parameters for mobilization, CDM staff teams were assembled. Two field teams were assembled, lead by CDM Field Program Coordinator Julie Gagen, and supported in-office by CDM's Technical Project Manager, Karen Kelley. Laboratory services were arranged with the UMass Dartmouth SMAST laboratory and the Biodiversity Field Program Coordinator was notified. Equipment was supplied by the CDM field equipment room.



**Figure 3. USGS Daily Mean Streamflow Gage Height, May 11 – September 7, 2010, USGS Gage #01108000, Taunton River near Bridgewater, MA**



**Figure 4. USGS Mean Streamflow Daily Discharge, May 11 – September 7, 2010, USGS Gage #01108000, Taunton River near Bridgewater, MA**



National Oceanographic and Atmospheric Administration (NOAA)  
 Selections from Weather Station Report  
 August 28 - September 1, 2010  
 Taunton, MA

Explanation of the Preliminary Climate Data (F6) Product

*Please note this information is preliminary and subject to revision. Official and certified climatic data can be accessed at the National Climatic Data Center (NCDC) (<http://www.ncdc.noaa.gov/oa/ncdc.html>).*

PRELIMINARY LOCAL CLIMATOLOGICAL DATA (WS FORM: F-6)

STATION: TAUNTON, MA

LATITUDE: 41 53 N

MONTH: AUGUST - SEPTEMBER

LONGITUDE: 71 01 W

YEAR: 2010

1	2	3	4	6A	6B	7	10	11	12	15	16	17	18
Day	Temperature					Precip							
DY	MAX	MIN	AVG	HDD	CDD	WTR	Avg SPD	Mx SPD	2-min DIR	S-S	WX	SPD	DR
23	68	61	65	0	0	0.54	9.4	20	40	10	1	32	20
24	64	60	62	3	0	0.69	8.6	15	30	10	1	26	30
25	68	62	65	0	0	1.31	6.8	16	360	10	1	25	350
26	84	57	71	0	6	0	4.9	15	280	4	22	280	--
27	79	50	65	0	0	0	3.3	12	280	0	16	310	--
28	81	46	64	1	0	0	2.5	9	340	0	1	15	320
29	92	54	73	0	8	0	2.3	10	350	0	1	20	300
30	91	53	72	0	7	0	2	10	270	0	1	21	330
31	95	59	77	0	12	0	1.9	9	340	0	1	14	330
1	93	62	78	0	13	0	3.5	12	210	0	12	17	270

SM 2549 1785 11 170 3.83 0.0 140.5 M 107

AV 82.2 57.6 4.5 FASTST PSBL 3 MAX(MPH)  
 MISC ----> 20 40 32 20

NOTES:

# LAST OF SEVERAL OCCURRENCES

COLUMN 17 PEAK WIND IN M.P.H.

PRELIMINARY LOCAL CLIMATOLOGICAL DATA (WS FORM: F-6) , PAGE 2

TEMPERATURE DATA

AVERAGE MONTHLY: 69.9  
 DPTR FM NORMAL: M  
 HIGHEST: 95 ON 31  
 LOWEST: 45 ON 14

PRECIPITATION DATA

TOTAL FOR MONTH: 3.83  
 DPTR FM NORMAL: M  
 GRTST 24HR M ON M  
 SNOW, ICE PELLETS, HAIL  
 TOTAL MONTH: 0.0 INCH  
 GRTST 24HR M  
 GRTST DEPTH: M

SYMBOLS USED IN COLUMN 16

1 = FOG OR MIST  
 2 = FOG REDUCING VISIBILITY  
 TO 1/4 MILE OR LESS  
 3 = THUNDER  
 4 = ICE PELLETS  
 5 = HAIL  
 6 = FREEZING RAIN OR DRIZZLE  
 7 = DUSTSTORM OR SANDSTORM:  
 VSBY 1/2 MILE OR LESS  
 8 = SMOKE OR HAZE  
 9 = BLOWING SNOW  
 X = TORNADO



## SAMPLE COLLECTION AND FIELD ACTIVITIES

### Water Quality Sampling Field Process

At the start of the day the two CDM teams met at sample location #6, Meadow Brook, West Union Street, East Bridgewater, to review the Health and Safety Plan (HASP), sample procedures (QAPP and SAP), and calibrate all field equipment. Field calibration sheets were used to document performance comparison of three (3) YSI meters to check pre-calibration and, based on those results, determine which meters to use in the early morning diurnal dissolved oxygen (DO) survey. All equipment calibration sheets can be found in **Attachment B**. Once the meters were checked, teams mobilized to measure DO levels at each of their five specified locations. The teams were as follows:

- Team 1: Julie Gagen and Steven Carey – Sample Locations #1 – 5
- Team 2: Chris Buerkle and Danielle Lemoi – Sample Locations #6 – 10

The Technical Project Manager, Karen Kelley, was the in-office contact for all field activities.

Field parameters collected between 7 and 9 AM included: temperature, conductivity, specific conductivity, DO (mg/L), and DO (%). The purpose of this early morning survey was to assess diurnal DO sag. In general, accepted measurements were typically between 3-6 mg/L or 40 – 70%. Morning DO field sheets can be found in **Attachment C**.

Upon completion of initial DO measurements, the teams checked YSI calibration. Team 1 determined that YSI #4182 had lost DO calibration during morning sampling as a result of a detached DO probe. Once the probe was replaced and re-calibrated, in cooperation with the CDM Equipment staff, the meter was determined to be suitable for use. The calibration page can be found in **Attachment B**. The calibration check for the Team 2 YSI (#4182) was within acceptable range and did not require calibration.

Laboratory samples were collected at sample locations following the morning diurnal DO measurements, along with a second set of in-situ measurements of field parameters. The sample parameters and associated laboratory bottles included:

- Particulate Carbon and Nitrogen, Alkalinity – Clear, 1 L bottle
- Chlorophyll-a – Amber 1 L bottle
- Total Phosphorus – 60 mL bottle
- Nutrients – 60 mL bottle, filtered
- Winkler Dissolved Oxygen – 300 mL glass DO bottle
- Turbidity (with Turbidimeter only)



**Figure 5. S. Carey monitoring field parameters with a YSI unit at Sample Location #5, 9/02/2010**

Samples were collected as instructed at each of the ten sample locations. Field sheets, which were completed during sampling activities, can be found in **Attachment C**.

The final round of DO measurements was conducted between 2:00 and 5:30 PM. Just as in the morning diurnal round, teams visited each of their 5 sampling sites to measure DO levels and record other in-situ parameters. DO values were typically between 5-7 mg/L or 80 – 100% of saturation. The field sheets can be found in **Attachment C**.

All samples collected in bottles were delivered via courier to the UMass S Mast laboratory by Danielle Lemoi of CDM, where Chain of Custody documents were signed to Sara Sampieri at the UMass laboratory.

Sample quality control measures included duplicate field parameter readings and collecting blank and duplicate samples. Field parameter readings were duplicated for 10% of the samples or six locations. Field sheets for the quality control samples, along with tabulated results from all DO diurnal measurements, can be found in **Attachment C**. Two blanks samples were collected: one equipment blank and one field blank. Both were used to test field equipment decontamination procedures, field collection procedures, and laboratory analysis procedures.

End of day calibration was conducted at the original sample location #6. At this time, each of the three YSI meters used for in-situ measurements was assessed for calibration. Documentation for the calibration assessment can be found in **Attachment B**.

### Diurnal Dissolved Oxygen Survey

Upon completion of all field activities September 2, the Field Team Leader contacted the Technical Project Manager to report completion of all field activities. After reviewing the afternoon DO measurements, it was clear that the morning results for Team 1 were likely inaccurate due to the problem with calibration of the YSI unit described above. After discussing with additional QC staff, Karen Kelley determined that a second morning sample round would be conducted September 3 as a quality check for previous results. No precipitation occurred between September 2 and September 3 sampling.

On September 3, 2010, Karen Kelley and Julie Gagen conducted a second morning diurnal survey of all ten sample locations between 6:00 and 9:30 AM. Field parameters recorded during this assessment included: temperature, conductivity, specific conductivity, DO (mg/L), DO (%), and pH. Results of this survey are shown in the table below. Field Worksheets can be found in **Attachment D** and a summary of the DO results is shown in Table 3.

Table 3. Diurnal Dissolved Oxygen Survey Results

Diurnal Dissolved Oxygen Survey Results							
AM Measurements from Friday September 3, 2010							
PM Measurements from Thursday September 2, 2010							
Sample Location	Time	Temp (°C)	Conductivity (ms/cm)	Sp. Cond. (ms/cmc)	DO (mg/L)	DO (%)	pH**
1	8:16	21.75	466	497	6.12	69.9	6.69
1	17:29	24.20	495	503	7.44	88.9	--
2	7:54	22.64	619	648	6.42	74.5	6.94
2	17:11	24.07	671	684	7.57	90.2	--
3	7:26	22.49	597	627	5.32	61.4	6.90
3	16:22	24.20	668	678	10.93	130	--
4	7:08	21.74	290	309	5.53	63.3	6.91
4	16:07	24.72	316	318	8.71	105	--
5	6:50	22.81	612	639	6.00	69.8	7.10
5	15:43	24.37	614	621	7.92	95	--
6*	7:03	22.35	487	463	5.07	58.5	6.59
6*	14:45	24.61	488	485	5.73	69	--
7	8:41	24.78	260	261	4.89	58.9	6.22
7	15:05	26.94	258	268	7.35	92.2	--
8	9:08	23.00	596	620	6.36	74.2	7.12
8	16:45	24.29	592	584	6.91	82.6	--
9	9:28	23.55	501	515	6.24	73.7	7.15
9	17:10	24.79	551	549	7.43	89.6	--
10*	9:05	21.09	288	267	3.71	41.4	6.71
10	17:25	24.50	291	288	4.13	49.9	--
*Observations are shown from 9/2; meter readings for this station were not affected by calibration challenges							
**pH was field measured once at each location							

## Water Quality Sampling Field Activities

Field activities records follow this report in Attachments A through E. The records include:

### Attachment A. Antecedent Weather Conditions & Field Mobilization

- Project personnel sign-off sheets
- USGS daily mean & streamflow data
- NOAA weather conditions

### Attachment B. Equipment Calibration Forms

### Attachment C. In-Situ Measurements (Dissolved Oxygen) Monitoring Forms

- Dissolved oxygen diurnal survey field forms
- In-situ measurements monitoring forms

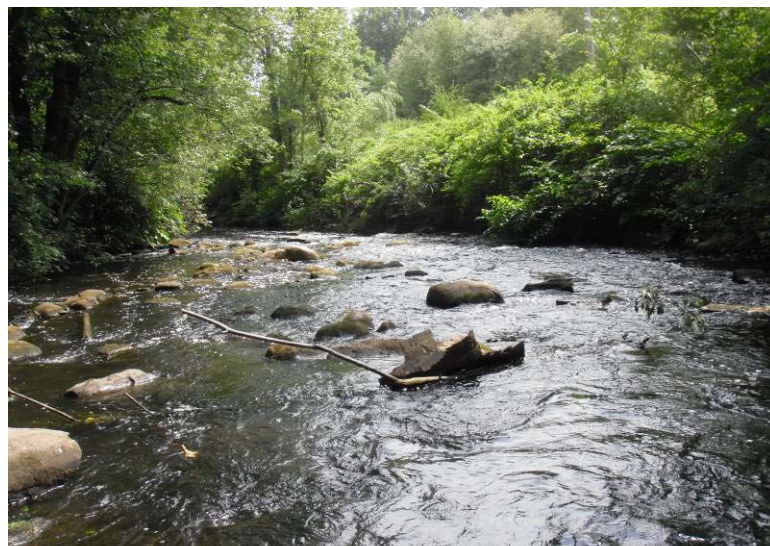
### Attachment D. In-Situ Measurements Field Worksheets from September 3, 2010

### Attachment E. Field Documentation

- Field logbooks
- Photographs

## LABORATORY DATA

All water quality laboratory analyses were performed by the UMass Dartmouth SMAST laboratory. The final laboratory report, which includes signed chain of custody forms, sample receipt log-in and checklist forms, a case narrative, analytical results, initial and continuing calibration results, method blank results and raw data, laboratory control sample results and raw data, is attached in **Attachment F**.



**Figure 6. Matfield River Streamflow at Sample Location #5 during Sample Location Siting, August 4, 2010**

### Data Summary Tables

Data summary tables for in-situ measurements can be found in Attachment C. Laboratory results tables, in full, are located in Attachment F and can be found in Table 4.

**Brockton Receiving Water Assessment SEP**

September 2010 Low-Flow Water Quality Survey

**Table 4. Laboratory Results from UMass Dartmouth SMAST Laboratory**

		Ortho- Phosphate (PO <sub>4</sub> ) mg/L	Total Phosphorus (TP) mg/L	Ammonia (NH <sub>4</sub> ) mg/L	Nitrate + Nitrite (NO <sub>x</sub> ) mg/L	Dissolved Inorganic Nitrogen (DIN) mg/L	Dissolved Organic Nitrogen (DON) mg/L	Particulate Carbon (POC) mg/L	Particulate Nitrogen (PON) mg/L	Carbon/ Nitrogen Ratio (C/N) Ratio	Chloro- phyll-a (Chl-a) ug/L	Phaeo- pigment (Phaeo) ug/L	Chlorophyll-a/ Total Pigment Chl-a/Chl-a+Phaeo ratio	Total Pigment Chl-a + Phaeo ug/L
Sample ID	Date	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	Ratio	ug/L	ug/L	ratio	ug/L
BR1-001	9/2/2010	0.018	0.048	0.190	0.709	0.899	0.379	0.542	0.069	9.21	1.03	<0.05	1.0	1.06
BR1-002	9/2/2010	0.016	0.055	0.644	2.18	2.82	0.549	0.551	0.07	9.25	0.62	0.11	0.85	0.72
BR1-003	9/2/2010	0.015	0.054	0.377	2.30	2.68	0.551	0.423	0.052	9.49	0.56	0.07	0.90	0.62
BR1-004	9/2/2010	0.008	0.026	0.111	0.438	0.549	0.627	0.388	0.047	9.54	0.60	0.12	0.83	0.72
BR1-005	9/2/2010	0.028	0.047	0.139	2.29	2.43	0.645	0.719	0.072	11.6	0.71	0.22	0.77	0.93
BR1-006	9/2/2010	0.018	0.042	0.117	0.684	0.801	0.641	0.735	0.087	9.87	3.02	<0.05	1.0	3.05
BR1-007	9/2/2010	0.045	0.075	0.056	0.174	0.229	0.569	0.679	0.084	9.48	5.39	<0.05	1.0	5.42
BR1-008	9/2/2010	0.020	0.049	0.113	2.42	2.53	0.533	0.384	0.043	10.5	0.70	0.16	0.82	0.85
BR1-208 <sup>1</sup>	9/2/2010	0.018	0.046	0.085	2.35	2.44	0.508	0.383	0.041	11.0	0.61	0.08	0.88	0.69
BR1-009	9/2/2010	0.025	0.064	0.069	2.01	2.08	0.441	0.353	0.038	10.7	2.65	<0.05	1.0	2.68
BR1-010	9/2/2010	0.005	0.018	0.047	0.308	0.355	0.402	0.432	0.047	10.8	1.18	<0.05	1.0	1.20
BR1-105 <sup>2</sup>	9/2/2010	<0.003	<0.002	0.073	0.003	0.076	0.122	0.033	0.002	15.6	<0.05	<0.05	NA	<0.05
BR1-305 <sup>3</sup>	9/2/2010	<0.003	0.002	0.073	0.007	0.079	0.158	0.038	0.003	12.8	<0.05	<0.05	NA	<0.05

1. Sample BR1-208 is the field duplicate for Sample BR1-008

2. Sample BR1-105 is the field blank

3. Sample BR1-305 is the equipment blank



## BIOLOGICAL SURVEYS

Biological monitoring was performed by a team of Biodrawiversity biologists led by Biodrawiversity Field Program Coordinator Ethan Nedeau September 2-3 at six sites on the main stem Matfield river. Biological surveys included benthic macroinvertebrates and habitat assessment, fish survey, periphyton assessment (quantitative), and macrophyte assessment (qualitative) at six mainstem sampling locations.

Biodrawiversity's report, including detailed results and discussion of the biological surveys is included as **Attachment G**.

There was a significant rain event from August 23-25, which caused discharge in the Taunton River (USGS Gauge 01108000) to rise from 45 cfs on August 22 to a daily peak of 715 cfs on August 26. Flows then dropped to 160 and 102 cfs when biological surveys began and concluded, respectively. Recently deposited debris on streambanks and water stains on streamside vegetation indicated that water levels might have risen by at least two feet in the Salisbury Plain River as a result of the August 23-25 event.

The significance of the high flows for the outcome of the biological sampling is not certain. Although water levels were not at August baseflow conditions when sampling occurred, neither the water depth nor flow velocity impeded the sampling or



**Figure 7. Biodrawiversity collecting biological samples**

affected the protocols. One periphyton tray was missing (Site 5); it was placed in an obscure location in a river that almost nobody fishes or paddles, and high flows are believed to have caused the tray to become untethered. The five trays that withstood the August 23-25 event may have been scoured, subjected to unusually strong flows, or fouled with floating debris (especially strands of vegetation). If so, there was little debris on the trays when they were inspected on August 31, and when collected September 2, the trays were in a normal position. It was fortuitous that floating trays were used because they remained at the

same depth and same light environment despite the high flows, and were not subjected to nearly as much scour from bedload or fouling from other debris.

The higher flows probably did not affect results of fish or macrophyte sampling, or habitat assessments. Floods do have the potential to reduce the standing crop of invertebrates, but the RBP III metrics focus on community composition and relative abundance, rather than total abundance and biomass, and it is unlikely that high flows affected the outcome of the macroinvertebrate community analysis. Although it was unfortunate that high flows occurred during the periphyton colonization period and were not at baseflow levels when sampling occurred, the overall effect on results of the biological surveys is considered minimal.



## Habitat Assessment, Macrophyte Assessment and Fish Population Survey

The biological communities in the Salisbury Plain River and Matfield River are mostly comprised of habitat generalists that are common in low-gradient warmwater streams of the Massachusetts coastal plain.

- Only seven fish species were detected; tessellated darters comprised 86 percent (184 of 214) of all fish captured.
- The aquatic plants included a mix of common native and non-native species, and although distribution and abundance was highly variable, there was little difference in species composition upstream to downstream.
- Habitat conditions are suboptimal or poor throughout these rivers.

It does not seem that fish or plants provide a particularly strong signal of environmental stress.

## Benthic Macroinvertebrates

One of the most striking aspects of the biological samples from the Salisbury Plain River and Matfield River is the near absence of pollution intolerant macroinvertebrate taxa, especially the EPT taxa.

- The caddisflies *Cheumatopsyche* sp. and *Hydropsyche betteni* were the only EPT taxa consistently found, yet these are among the most tolerant stream caddisflies and are often used as indicators of organic pollution rather than indicators of clean water.
- No stoneflies and only two individual mayflies were detected, despite the presence of suitable habitat in four of the survey sites.

Macroinvertebrate samples were comprised of a low diversity of habitat generalists that are tolerant of a range of conditions in warmwater streams.

## RBP III Analysis

The RBP III analysis determined that Site 1 (upstream control) was severely impacted. Ironically, this was the upstream control for this study. It had both the lowest percent comparability to the reference site (total metric score of 8, percent comparability of 19 percent) and the lowest habitat score. All of the other sites in the Salisbury Plain River and Matfield River would be considered “non-impacted” compared to Site 1.

An abnormally high autotrophic index at the upstream control (Site 1) is a strong indicator of poor water quality. Site 1 (upstream reference) also returned the lowest chlorophyll *a* values and the second lowest productivity index. The autotrophic index dropped almost 50 percent downstream of the AWRF (but was still high) and then fell to within a normal range at sites 3, 8, and 9. Chlorophyll *a* increased gradually from Site 1 to Site 2 (0.33 – 1.07 mg/m<sup>2</sup>) and from Site 2 to Site 3 (1.07 – 5.39 mg/m<sup>2</sup>), and then jumped to 34.59 mg/m<sup>2</sup> by Site 8. There seems to be a general trend from a highly polluted, fungal/bacterial-dominated river upstream of Brockton’s AWRF to a more typical nutrient-rich, algal-dominated river downstream.

It is difficult to quantify the effects of Brockton's AWRF on biological communities because of the highly degraded state of the Salisbury Plain River upstream of the facility. A suitable upstream control does not exist.

## QUALITY ASSURANCE/QUALITY CONTROL AND DATA VALIDATION

The project quality objectives are qualitative and quantitative statements that specify the quality of data required to support defensible decisions related to specific environmental problems. The project quality objectives are based on the end uses of the data to be collected; as such, different data uses may require different type and level of data quality. The data collection and analysis procedures for the Brockton Receiving Water Assessment SEP were designed to meet the established project quality objectives. Data quality assurance/quality control procedures for this project are documented in the project Quality Assurance Project Plan (QAPP).

The following project quality objectives have been developed for the Brockton Receiving Water Assessment SEP:

- Collect water quality and biological/habitat data to support characterization of the impacts of improvements to the Brockton Advanced Water Reclamation Facility (AWRF) on the river.
- Collect water quality data to support an Aquatic Life use assessment of the mainstem Salisbury Plain and Matfield Rivers.

These objectives were used to select sampling locations, as well as suitable sampling methods, measurement techniques, and analytical protocols with the appropriate quality assurance and quality control guidelines.

The Commonwealth of Massachusetts categorizes waters according to their use class. Each class is associated with a series of designated uses; the ability of a water body to support these uses is assessed based on its ability to meet the applicable water quality standards. The Salisbury Plain and Matfield Rivers in the study area are classified as Class B Warm Water fisheries.

## Assessment and Response Actions

Performance audits of both laboratory and field activities were conducted to verify that sampling and analysis were performed in accordance with the procedures established in the QAPP and corresponding Field Sampling and Analysis Plan. Field and laboratory performance audits were performed through a review of internal quality control checks and procedures, of the data being generated.

As mentioned previously, upon completion of all field activities, the Field Team Leader contacted the Technical Project Manager to report completion of all field activities. After completing afternoon DO measurements, it was clear that the AM diurnal results for Team 1 were invalid. After discussing with additional QC staff, Karen Kelley determined that a second early morning sample round would be conducted in the morning of September 3 to replace invalid data and as a quality check for previous results.

On September 3, 2010, Karen Kelley and Julie Gagen conducted a survey of all ten sample locations between 6:00 and 9:30am. Field parameters recording during

this assessment included: temperature, conductivity, specific conductivity, DO in mg/L, DO %, and pH. Field Worksheets with the complete results of this survey can be found in **Attachment D**, and a summary of DO values and the other field parameters measured is shown in Table 3.

## REFERENCES

CDM, 2010(a). Sampling and Analysis Plan for Year 2010-2011, Brockton Receiving Water Assessment Supplemental Environmental Project (SEP). September 7, 2010.

CDM, 2010(b). Quality Assurance Project Plan for Brockton Receiving Water Assessment SEP Study, Revision 01. September 7, 2010.

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